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Report of Cabot Oil & Gas Corporation's Utilization of Effective Techniques for
Protecting Fresh Water Zones/Horizons During Natural Gas Well Drilling,
Completion and Plugging Activities

Introduction

On April 15, 2010, the Pennsylvania Department of Environmental Protection (the "PA DEP") and Cabot entered into a modification to the November 4, 2010 Consent Order & Agreement (the "Modification"), concerning 14 gas wells located in Dimock and Springville Townships, Susquehanna County (the "Affected Area"). The issues addressed in the Modification include, among other things, concerns with the integrity of tubular goods (casing), cement, and cementing practices.

I have been tasked with analyzing the wells' completion design and mechanical integrity of the surface and subsurface elements making up the well. This includes an analysis of the adequacy of: (i) the grade, weight and amount of tubular goods; (ii) the cement grade, its additives; and amount of cement in terms of height in the well bore; and (iii) the pre-cementing well bore conditioning and cementing process that were employed by Cabot during the construction of the gas wells identified in the Modification. My analysis included a review of the following types of documents maintained by Cabot:

- The April 15, 2010 Modification;
- Detailed morning reports;
- Well Record and Completion Reports [PA DEP Forms 5500-FM-OG0004 Rev. 1/2007];
- Cabot Report of Casing/Cement Integrity Testing, dated February 1, 2009;
- Well Bore Schematics that identify: (i) the weight, grade, diameter and setting depth of the tubular goods; (ii) cement type and amount; and (iii) the location of the completed zones;
- Tubular goods tallies;
- Service company pumping and cementing records;
- Dimension and strength data for both Limited Service ("LS") and API graded pipe that include: (i) OD [outside diameter]; (ii) ID [inside diameter]; (iii) t [wall thickness]; (iv) weight in pounds per foot; and (v) metallurgical grade (API classifications);

- CBLs [cement bond logs]; and
- Mud logs.

After an extensive review of Cabot's natural gas well design and the mechanical integrity of the surface and subsurface elements, including the adequacy of: (i) tubular goods; (ii) cementing practices; and (iii) the processes Cabot employed during the construction and/or remedial work on the gas wells identified in the Modification, I conclude the following:

- Cabot has used and is using procedures for drilling, casing and cementing that meet or exceed the requirements of the Pennsylvania Oil & Gas Act;
- Cabot has used and is using procedures for drilling, casing and cementing that are at least equivalent to, if not better than, other producers in the industry;
- No Cabot well that has been drilled or plugged is currently causing or allowing methane migration into groundwater;
- The procedures Cabot are utilizing for natural gas well development in Susquehanna County are not causing or allowing methane migration into the waters of the Commonwealth;
- The procedures Cabot intends to use in the future for natural gas well development in Susquehanna County will not cause or allow methane migration into the waters of the Commonwealth.

More specifically:

- Cabot has plugged the Gesford Nos. 3 & 9 Wells and the Baker 1 Well in accordance with 25 Pa. Code §§ 78.91-78.95;
- Cabot has undertaken and completed the remedial work for the Ely No. 4 Well as required by the Modification;
- The current configurations contained within the subsurface elements of the remaining 10 wells identified in the Modification comply with 25 Pa. Code §§ 78.91-78.98.

Detailed Summary

The following is a detailed analysis setting forth the support for my findings concerning the 14 gas wells identified in the Modification:

I. Modification, ¶ 5.4.i.2

Pursuant to ¶ 5.4.i.2 of the Modification, Cabot was required to plug the Gesford Nos. 3 & 9 Wells, and Baker No. 1 Well. The following is a summary of the operations undertaken by Cabot to satisfy this requirement:

A. Gesford No. 3 (API No. 37-115-20019-00) [See, App., Ex.1, Tab A for the well schematic.]

This well was drilled and completed during the period of October 13, 2008 through December 16, 2008. Its original depth was 7058 feet KB.

A review of the well schematic and original well completion report indicates that the well was equipped as follows:

- 47 feet KB of 78.7 lb/ft, 20 inch LS casing was used as the conductor pipe. [See, App., Ex. 2 for all specifications for casing used in each of Cabot's wells.] Schlumberger pumped 10 barrels of freshwater followed by 42 barrels of Class A cement containing 2% Calcium Chloride. It was displaced using ½ barrel of freshwater. It should be noted that approximately 2 barrels of the cement slurry were recovered at the surface in the well pit. [See, App., Ex. 3 for the specifications for cement additives used in Cabot's wells.]
- 280 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as a second conductor. Prior to cementing the 13 3/8 inch casing, Schlumberger conditioned and cleaned the well bore by pumping 5 barrels of freshwater. 260 sacks of Class A cement were then mixed, pumped and displaced using 40.8 barrels of freshwater. During the drilling of the 12 ¼ hole, the 13 3/8 inch casing seat failed. Schlumberger then pumped 300 sacks of Class A cement containing 2% Calcium Chloride and ¼ lb per sack of Celloflake into the annular space. It should be noted that approximately 14 barrels of the cement slurry were collected at the surface in the well pit.
- There was a freshwater show at 350 feet.
- 892 feet KB of 26 lb/ft, 9 5/8 inch LS casing was used as a water protection string. Prior to cementing the 9 5/8 casing, Schlumberger circulated the hole using freshwater for 1 hour to clean and condition the hole. Schlumberger then pumped 25 barrels of freshwater followed by 1 barrel of 6% gel. 300 sacks of Class A cement containing 2% Calcium Chloride were displaced into the annular space using 71 barrels of freshwater. It should be noted that approximately 8 barrels of the cement slurry were recovered at the surface in the well pit.
- A gas show amounting to 900 mcf per day was detected at 1560 feet KB. Schlumberger Wireline conducted a wireline log survey that indicated that the gas entry was at 1459 feet KB to 1503 feet KB.

- 1673 feet of 23 lb/ft, 7 inch J-55 casing was used as an intermediate conductor. Prior to cementing the 7 inch casing, Schlumberger cleaned and conditioned the hole by pumping 15 barrels of freshwater that was followed by 20 barrels of 6% gel, and then 15 barrels of freshwater. 170 sacks of Class A cement containing 4% gel, 2% Calcium Chloride, 0.2% defoamer, ¼ lb per sack of Celloflake, and 0.4% fluid loss was pumped into the casing as the lead cement. This was then followed by the tail cement slurry that was comprised of 250 sacks of Class A cement, containing 2% Calcium Chloride. These cement slurries were displaced into the annular space using 67 barrels of freshwater. It should be noted, that approximately 9 barrels of the cement slurries were recovered at the surface in the well pit. Following this cementing operation, Schlumberger grouted/pumped 1 barrel of cement down the 9 5/8 x 7 inch annular space.
- 6974 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing was used as the production string. Prior to cementing the 4 ½ inch casing, BJ Services circulated the hole for the purposes of cleaning and reconditioning. BJ Services then pumped 5 barrels of freshwater, followed by 25 barrels of mud flush, followed by 10 barrels of freshwater. 180 sacks of Class A cement, containing 2% gel and 2% Calcium Chloride were then displaced by 108 barrels of freshwater into the annular space. Schlumberger Wireline conducted a CBL and determined that the top of the cement was at 5293 feet KB.
- Following the initial completion Schlumberger remediated a small portion of the 4 ½ x 7 inch annular space by squeezing cement into it. Schlumberger Wireline Services perforated the 4 ½ inch casing from 5150 feet KB to 5152 feet KB using four shots per foot. 220 barrels of treated fluid were displaced through the perforations into the annular space. 380 sacks of Type 1 (Class A/Portland common cement), containing 0.1% defoamer, 0.2% fluid loss, and latex additive were displaced with 79 barrels of treated water. The top of cement was estimated by CBL to be at 880 feet KB.
- 6651 feet KB of 4 lb/ft, 2 3/8 EUE J-55 tubing was used as a velocity string. Well was turned online.

This well was plugged back to surface in accordance with the Modification.

- The well was killed using 100 barrels of freshwater. Superior Well Services spotted the first cement plug from 6968 feet KB to 5045 feet KB, with 135 sacks of Class A cement, containing 0.2% CD 20 [dispersant], 0.5% LP 2 [GasBlok], and 0.35% Super CR 1 [retardant]. The top of the cement plug was tagged and determined to be at 5045 feet KB. The cement plug was tested by holding a pressure of 1000 psi for 30 minutes.

- The second plug was spotted from 5045 feet KB to 4000 feet KB of Class A cement, containing 0.2% CD 20, 0.5% LP 2, and 0.35% Super CR 1.
- The third plug was spotted from 4000 feet KB to 2800 feet KB with 103 sacks of Class A cement, containing 0.2% CD 20, 0.5% LP 2, and 0.35% Super CR 1. The cement plug was tested by holding a pressure of 2000 psi.
- Warrior Wireline perforated the 4 ½ inch casing from 1682 feet KB to 1680 feet KB, using 4 shots per foot. Circulation was then established. 3 barrels of MC 500 Microfine cement [see App., Ex. 4 for Microfine specifications] in total was pumped into the 4 ½ inch x 7 inch annular space. The top of cement was determined to be at 1574 feet KB.
- Warrior Wireline then perforated the 4 ½ inch casing from 1502 feet KB to 1500 feet KB using 4 shots per foot. Circulation was then established by pumping 30 barrels of freshwater. 2 ½ barrels of MC 500 Microfine cement was displaced through the perforations into the annular space. The annular space was opened to a chart recorder to measure the pressure on the annular space. Recorder indicated a pressure on the annulus of 0 psig.
- Warrior Wireline then perforated the 4 ½ inch casing from 1322 feet KB to 1320 feet KB using 4 shots per foot. Communication with the 4 ½ inch annular space was established by pumping/displacing freshwater into it. 3.9 barrels of MC 500 Microfine were then pumped/squeezed through the perforations.
- A notch was cut at 900 feet KB into the 4 ½ inch and 7 inch casings using a jet cutter. 3 barrels of acetic acid and 1 barrel of freshwater at a rate of 0.6 barrels per minute were then pumped into the notch. 2.5 barrels of MC 500 Microfine cement were then pumped/displaced into the notch. Of the 2.5 barrels of MC 500 Microfine cement, 1.3 barrels of it were displaced into the annular space. The pressure on the annular space between the 4 ½ inch and 7 inch casings was then measured to be 0 psig.
- Superior Well Services spotted a cement plug from 877 feet KB to 450 feet KB using 24 sacks of Class A cement containing 0.2% CD 20, 0.5% LP 2, and 0.35% Super CR 1.
- A second notch was cut at 425 feet KB in the 4 ½ inch and 7 inch casings using a jet cutter. 425 feet of 4 ½ inch casing was then pulled from the well. A third notch was cut at 410 feet KB through the 7 inch and 9 5/8 inch casings in order to set a plug that extended to the drilled well bore.
- JW Wireline then perforated the 7 inch and the 9 5/8 inch casings from 398 feet KB to 400 feet KB using 4 shots per foot. 3 barrels of MC 500 Microfine cement were then displaced into the perforations and notch.

- A fourth notch was cut at 300 feet KB into the 7 inch and 9 5/8 inch casings using a multi-string casing cutter. 4 barrels of MC 500 Microfine cement were displaced into the perforations and notch using 1.3 barrels of freshwater. The top of cement was measured at 238 feet KB. The well was then shut in.
- The hole was then filled with pea gravel. A cap was then welded on the hole and a monument was set.

In summary, the Gesford No. 3 was plugged in accordance with 25 Pa. Code §§ 78.91 – 78.95. Further it should be noted that the objective of well plugging was to isolate the subsurface from the near surface. To achieve this objective Cabot cut notches in the casing string(s) and cement sheath to bring the squeezed cement into contact with the drilled well bore. The effect of this action is to assure isolation of subsurface fluids to below the cement plug and to eliminate the possibility of vertical migration of lower-formation gas.

B. Gesford No. 9 (API No. 37-115-20187-00) [App., Ex. 1, Tab B]

This well was plugged back to surface in accordance with the Modification.

A review of the well schematic and original well completion report indicates that the well was originally equipped as follows:

- 190 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as the conductor pipe. Prior to cementing the 13 3/8 inch, BJ Services first pumped 5 barrels of freshwater to clean and condition the well bore. 132 sacks of Class A cement was then pumped into the well bore and displaced into the annulus with 26 barrels of freshwater. It should be noted that approximately 1 barrel of the cement slurry was recovered at the surface in the well pit.
- There was a freshwater show at 350 feet KB.
- 857 feet KB of 26 lb/ft, 9 5/8 inch LS casing was used as a water protection string. Prior to cementing the 9 5/8 inch casing, the hole was circulated for the purposes of cleaning and conditioning it. Included in this cleaning and conditioning operation were 3 viscous pills sweeps. Schlumberger Well Services pumped 10 barrels of freshwater, followed by 40 barrels of chemical wash [D 827 (Chemical Wash CW 100)], and this was then followed by 5 barrels of freshwater. 336 sacks of Class A cement containing 0.2% D 46 [defoamer], 0.75 gallons per sack of D 500 [GasBlok LT], 0.3 gallons per sack of D 186 [cement set enhancer LT], and 0.1 gallons per sack of D 185A [low temperature dispersant] were then pumped into the hole and displaced with 68 barrels of freshwater. It is noted that there were no visible cement returns to surface. The uncemented annular space was subsequently grouted using 75 sacks of

Class A cement. It should be noted that approximately 10 barrels of the cement slurry that were used in the grouting operation were subsequently recovered at the surface in the well pit. A CBL survey was conducted from 790 feet KB to surface. This log survey indicated that the entire annular space was filled with cement.

- 1435 feet KB of 23 lb/ft, 7 inch J-55 casing was used as the production string. Superior Well Services cemented the well by first cleaning and conditioning the hole by pumping 5 barrels of freshwater, followed by 10 barrels of mud flush, and then followed by 5 barrels of freshwater. 71.4 barrels of Class A cement were then pumped into the hole and displaced using 58.5 barrels of freshwater. It should be noted that a subsequent visual inspection resulting from the plugging operations indicated that the top of cement in the annular space between the 7 inch and 9 5/8 inch casing strings was at surface.

Pursuant to the Modification, Cabot plugged the well. The plugging operations began on April 2, 2010.

- The well was killed by loading it with freshwater from total depth to surface.
- The first cement plug was placed in the well from its total depth of 1911 feet KB to 877 feet KB. The cement used was Type 1 cement (Class A/Portland common cement) containing 0.75 gallons per sack of D 500 [GasBlok], 0.1 galls per sack of D 185 [dispersant], and 0.35% of D 201 [retardant].
- The 7 inch casing was then perforated from 860 feet to 862 feet KB, with four shots per foot for a total of 8 perforations. Following perforation, the perforations were pressured up to 1000 psi with no leak off after 30 minutes. The pressure on the well was then bled down to 0 psi.
- A cement retainer was then set at 850 feet KB. The well was then cemented from 850 feet KB to 450 feet KB using Class A cement containing 0.2% CD 20, 0.5 % LP 2, and 0.35% Super CR1.
- A notch was cut at 425 feet KB into the 7 inch and 9 5/8 inch casing strings using a mechanical cutter.
- Superior Well Services then pumped 3.2 barrels of Microfine cement that was displaced by 1.5 barrels of water into the notch. The top of the cement plug was determined to be at 325 feet.
- A notch was cut at 300 feet KB in the 7 inch and 9 5/8 inch casing strings using a mechanical cutter. A plug made up of 19 sacks of Microfine cement was set from 310 feet KB to 210 feet using the balance method.

An applied pressure of 300 psi was used to displace the cement into the notch. The well was then shut in.

- The hole was then filled with pea gravel. A cap was then welded on the hole and a monument was set.

In summary, the Gesford No. 9 was plugged in accordance with 25 Pa. Code §§ 78.91–78.95. Further it should be noted that the objective of well plugging was to isolate the subsurface from the near surface. To achieve this objective Cabot perforated and/or cut notches and squeezed in the casing string(s) and cement sheath to bring the squeezed cement into contact with the drilled well bore. The effect of this action is to assure isolation of subsurface fluids to below the cement plug and to eliminate the possibility of vertical migration of lower-formation gas.

C. Baker No. 1 (API No. 37-115-20026-00) [App., Ex. 1, Tab C]

The Baker No. 1 was plugged per the Modification.

A review of the well schematic and original well completion report indicates that the well was originally equipped as follows:

- 44 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as the conductor pipe. The annular space between the drilled 17 1/2 inch hole and the 13 3/8 inch casing was grouted from the surface with 25 sacks of Portland (Type 1/Class A)
- There was a show of freshwater at 990 feet KB.
- 1094 feet KB of 26 lb/ft, 9 5/8 inch LS casing was used as a water protection string. Prior to the cementing the 9 5/8 inch casing, BJ Services conditioned and cleaned the well bore by pumping 20 barrels of freshwater, followed by 15 barrels of gel, and followed then by 10 barrels of freshwater. 380 sacks of Class A cement containing 2% Calcium Chloride was then displaced into the annular space using 83 barrels of freshwater. It should be noted that approximately 10 barrels of the cement slurry were recovered at the surface in the well pit.
- The intermediate string was set at 1534 feet KB. It is made up of 31 joints of 19 lb/ft, 7 inch LS casing and 5 joints of 23 lb/ft, 7 inch J-55 casing. Prior to cementing the 7 inch casing, the well bore was circulated for the purposes of cleaning and conditioning. BJ Services cemented the well by displacing 40 barrels of freshwater, followed by 30 barrels of gel, and then followed by 10 barrels of freshwater. 140 sacks of lead cement (made up of Class A cement containing 4% gel, 2% Calcium Chloride, 0.2% defoamer, ¼ lb per sack of Flake and 0.4% of fluid loss agent) was displaced by the tail slurry, which was made up of 100 sacks of Class A cement containing 2% Calcium Chloride. The cement slurries were

displaced into the annular space using 59 barrels of freshwater. It should be noted that approximately 10 barrels of the cement slurries were recovered at the surface in the well pit.

- There was a gas show in the Manantango Shale at 5908 feet.
- 7311 feet KB 11.6 lb/ft, 4 ½ inch P-110 casing was used as the production string. Prior to cementing the 4 ½ inch casing, BJ Services pumped 45 barrels of treated fluid, 25 barrels of mud flush, and then 50 barrels of treated fluid to clear the shoe, and clean and condition the 6 ¼ inch well bore. BJ Services then cemented the 4 ½ inch casing with 365 sacks of Type 1 cement (Class A/Portland common cement) containing 2% Calcium Chloride and 2% gel. BJ Services then displaced the cement with 68 barrels of treated fluid. The cement locked up ending the cement job. The cement that was in the casing was subsequently drilled out to a depth of 7304 feet KB. Schlumberger Wireline conducted a CBL and determined that the top of the cement was at 7100 feet KB. Subsequent to the initial cement job, Cabot elected to conduct a remedial squeeze job using Schlumberger Services. The 4 ½ inch casing was perforated from 7001 feet KB with four shoots per foot. Attempts to displace cement using these perforations failed. As a result, the interval from 6860 feet to 6861 feet KB was perforated using four perforations per foot. As a result, four perforations were shot from 6860 feet KB to 6861 feet KB. Schlumberger Services pumped 200 barrels of treated water followed by 5 barrels of treated water, followed by 42 barrels of Class A cement containing 2% Calcium Chloride. The cement slurry was displaced using 106 barrels of freshwater. According to the well history, Schlumberger Wireline subsequently ran a CBL and indicated a top of cement at 5490 feet KB.
- A second cement squeeze job was conducted to remediate a portion of the 4 ½ x 7 inch annular space. Perforations for the squeeze were placed in the pipe from 5030 to 5032 feet KB. Schlumberger Services pumped 300 barrels of treated fluid to kill and circulate gas from the annular space. 50 barrels of 6% gel and 20 barrels of freshwater spacer were then pumped into the well. This was then followed by 343 sacks of Class A cement containing 0.1% defoamer, 0.2% fluid loss and latex. The cement slurry was then displaced using 77.5 barrels of freshwater.
- 6993 feet KB of 4.7 lb/ft, 2 3/8 inch J-55 EUE tubing was run into the well. The 2 3/8 inch tubing was used as a velocity string.

Pursuant to the Modification, the plugging operation began on May 1, 2010.

- The well was killed by circulating 265 barrels of freshwater down the 2 3/8 EUE tubing. Some gas and 3 barrels of water were recovered at the

surface. 231 joints of 4.7 lb/ft, 2 3/8 inch EUE tubing were then pulled from the well.

- The first cement plug was set at 7275 feet KB using 140 sacks of Class A cement containing 2% CD 20, 0.5 % of GasBlok, and 0.35% Super CR 1. The top of the cement plug was tagged at 5792 feet KB. The second plug was mixed and spotted from 5792 feet KB using 290 sacks of Class A cement containing 2% CD 20, 0.5 % of GasBlok, and 0.35% Super CR 1. The top of the cement plug was tagged at 3560 feet KB. The fall off in the height of the cement column indicated that 33 barrels of the cement slurry were displaced into the adjoining formation. 28 barrels of Class A cement containing 2% CD 20, 0.5 % of GasBlok, and 0.35% Super CR 1 were then pumped into the hole. The top of the cement plug was tagged at 1478 feet KB and subsequently determined using wireline logs to be at 1470 feet KB.
- 4 ½ inch casing was cut at 850 feet KB and then pulled. Superior Well Services then spotted a cement plug from 1418 feet KB to 500 feet KB. The cement plug was composed of 102 sacks Class A cement containing 0.45% CR 1, 0.2% CD 20, and 0.2% Air Out. Another cement plug was then spotted from 500 feet KB to 150 feet KB using 63 sacks of Class A cement containing 0.45% CR 1, 0.2% CD 20, and 0.2% Air Out. A third cement plug was then spotted from 150 feet KB to the surface using 27 sacks of Class A cement containing 0.45% CR 1, 0.2% CD 20, and 0.2% Air Out. The morning rig report indicated that the level of the cement was at the surface and after pump shut down, remained at that level.

Subsequent Operations:

- Subsequent operations were undertaken by Cabot beginning on June 3, 2010. Cabot cleaned out the hole to 1555 feet KB. This depth is beneath the 7 inch casing shoe at approximately 1534 feet.
- Using a mechanical cutter, the 4 ½ inch casing was cut at 1544 feet KB. Communication was then established between the 4 ½ casing through this notch and the drilled well bore. 5 barrels of MC 500 Microfine cement was then pumped into the hole, and freshwater used for displacement. The well bore was then pressured up to squeeze fine cement into the cut notch at 1544 feet KB. The top of cement was then determined to be at 1283 feet KB.
- Using a jet notch tool, a notch was cut at 1100 feet KB. A cement plug made up of 5 barrels of MC 500 Microfine cement was mixed and pumped. This plug was displaced with 6 barrels of fresh water. Possibly 1/10th barrel of cement was squeezed into the notch at 1100 feet KB. Following the squeeze, the top of the cement was determined to be at 820 feet KB.

- Using a multistring mechanical cutter, a notch was cut at 813 feet KB through both the 7 inch casing and 9 5/8 inch casing. 5 barrels MC 500 Microfine cement were then pumped into the hole and freshwater used for displacement. Top of cement was determined to be at 695 feet. A squeeze was then attempted by pressuring up the well bore to 813 psi and letting the imposed pressure bleed off. This process was repeated on three occasions.
- Mixed and pumped 90 sacks of Class A cement containing 0.2% CD 20, 0.5% LP 2, and 0.35% Super CR 1 from 695 feet to 200 feet. This cement slurry was displaced using 0.50 barrels of fresh water. The top of cement was determined to be at 200 feet.
- The 7 inch casing with then filled with pea gravel from 200 feet to the surface. A plate was then welded over the 9 5/8 inch to the 7 inch casing. A plate was then welded over the 7 inch casing with a vent. A 4 inch x 4 foot pipe was then welded to that cap with a plate welded to it with the well's API Number.

In summary, the Baker No. 1 Well was plugged in accordance with 25 Pa. Code §§ 78.91– 78.95. Further it should be noted that the objective of well plugging was to isolate the subsurface from the near surface. To achieve this objective Cabot perforated and/or cut notches and squeezed in the casing string(s) and cement sheath to bring the squeezed cement into contact with the drilled well bore. The effect of this action is to assure isolation of subsurface fluids to below the cement plug and to eliminate the possibility of vertical migration of lower-formation gas.

II. Modification, ¶ 5.4.i.3

Pursuant to the Modification, ¶ 5.4.i.3, Cabot was required to bring the Ely No. 4 well into compliance. Below is the analysis of the actions Cabot took to meet the requirement.

D. Ely No. 4 (API No. 37-115-20034-00) [App., Ex. 1, Tab D]

As per the terms of the Modification, Cabot reconditioned the well by squeezing the annular space. The procedure utilized called for perforating the 4 ½ inch casing between 1500 and 1502 feet. Approximately 5 barrels of micro-cement slurry was displaced/squeezed into 8 perforations. The action eliminated the pressure that was present in a portion of the annular space between the 4 ½ x 7 inch casing.

A review of the well history and completion report indicates that the company has addressed the issue of cement coverage over sands/shales that might present natural gas. The casing program is representative of a vertical well that is drilled to a depth of approximately 7000 feet:

- 35 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as the conductor pipe. This pipe is set in place.

- There was a freshwater show at 50 feet.
- 406 feet KB of 26 lb/ft, 9 5/8 inch LS casing was used as the primary water protection string. Prior to running the casing, the well was circulated for the purposes of cleaning and conditioning. BJ Services then pumped 5 barrels of freshwater, 20 barrels of 6% gel, and 5 barrels of freshwater ahead of the 150 sacks of Class A cement containing 2% Calcium Chloride. The cement slurry was then displaced into the annular space using 31 barrels of freshwater. It should be noted that approximately 15 barrels of cement slurry were recovered at the surface in the well pit.
- 1490 feet KB of 19 lb/ft, 7 inch LS casing was used as the intermediate string. Prior to running the casing, the well was circulated for the purposes of cleaning and conditioning the well bore. Prior to running the cement slurry, BJ Services then pumped 10 barrels of freshwater, 15 barrels of 6% gel, and 10 barrels of freshwater ahead of 140 sacks of Class A cement containing 4% gel, 2% Calcium Chloride, and ¼ lb per sack of Flake. This lead cement slurry was then displaced by the tail end cement, which consisted of 100 sacks of Class A cement containing 2% Calcium Chloride. The cement slurries were then displaced into the annular space using 60 barrels of freshwater. It should be noted that approximately 15 barrels of cement slurry were recovered at the surface in the well pit.
- 7225 feet KB of 11.6 lb/ft, 4½ inch M-80 casing was used as the production string. Prior to running the casing, the well bore was circulated with compressed air for the purpose of cleaning. BJ Services pumped 5 barrels of freshwater, followed by 10 barrels of mud flush and 5 barrels of freshwater. 130 sacks of Class A cement containing 2% Calcium Chloride and 2% gel was then displaced into the annular space using 112 barrels of freshwater. Using the CBL, the top of the cement was determined to be at 5790 feet KB. Two cement squeeze jobs were then conducted. The initial cement squeeze was undertaken by Halliburton. The 4 ½ inch casing was perforated from 5750 to 5752 feet KB, using 4 perforations per foot. 450 sacks of Class A cement containing 0.1% defoamer, 0.2% dispersant and latex was used in the squeeze operation. This cement squeeze brought the top of the cement column to approximately 1166 feet KB, as determined by CBL. A subsequent squeeze was conducted to eliminate channeling within the cement column, by perforating the 4½ inch casing from 1502 feet to 1500 feet, using 4 perforations per foot. This second squeeze operation utilized 23 sacks of Microfine 500 cement.
- 6705 feet KB of 4.7 lb/ft, 2 3/8 inch J-55 EUE tubing was run into the well and used as a velocity string.

In summary, as per the terms of the Modification, Cabot reconditioned the Ely No. 4 well by squeezing the annular space. This action also ensured compliance with 25 Pa. Code §§ 78.71-78.98. As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

III. Analyses of Remaining 10 Wells Identified in Modification ¶ 5.4.i.5

E. J. Brooks No. 1H (API No. 37-115-20051-00) [See, App., Ex. 1, Tab E]

A review of the well schematic indicates that the well is equipped as follows:

- 40 feet KB of 78.7 lb/ft 20 inch LS casing was used as the first conductor. This pipe was set in place.
- 160 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as the first water protection string. BJ Services then conditioned the 17 1/2 inch well bore using 20 barrels of gel and 5 barrels of freshwater. 170 sacks of Type 1 cement (Class A/Portland cement) containing 3% Calcium Chloride were then displaced using 21 barrels of freshwater. Four centralizers were utilized in accordance with the program.
- There were freshwater shows at 90 and 460 feet.
- 1289 feet KB of 26 lb/ft, 9 5/8 inch LS casing is used as the second water protection string. Centralizers were placed on the first, third, fifth and twenty-fourth joints. A cement basket was also placed on the twenty-fourth joint. BJ Services conditioned and cleaned the 12 1/4 inch well bore by pumping ahead of the cement slurry 35 barrels of water, followed by 25 barrels of 6 % gel and followed by 10 barrels of a water spacer. The lead cement, 75 sacks of Class A cement, contained 4% gel, 2% Calcium Chloride and 1/4 pound of flake. The tail cement was 100 sacks of Class A cement that contained 2% Calcium Chloride. The cement slurries were then displaced into the annulus with 103 barrels of freshwater. It should be noted that approximately 10 barrels of the cement slurries were recovered at the surface in the well pit.
- 1562 feet KB of 23 lb/ft, 7 inch J-55 casing is used as the intermediate string. This pipe is cemented in place by first pumping 35 barrels of freshwater, 35 barrels of 6% gel, and 10 barrels of freshwater to clean and condition the 8 3/4 inch well bore. The lead cement was made up of 75 sacks of Class A cement containing 4% gel, 2% Calcium Chloride and 1/4 lb per sack of Flake. The tail cement was made up of 100 sacks of Class A cement containing 2% Calcium Chloride. These cement slurries were

then displaced into the 7 inch by 8 ¾ inch annular space using 59 barrels of freshwater. It should be noted that approximately 8 barrels of the cement slurries were recovered at the surface in the well pit.

- 9429 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. This casing was not cemented in place. Cabot utilized the Packers Plus system, whereby an isolation packer was placed at 1417 feet KB.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that meet the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

F. Ely No. 5H (API No. 37-115-20054-00) [See, App., Ex. 1, Tab F]

A review of the well history and completion report indicates that the well is equipped as follows:

- 45 feet KB of 37 lb/ft, 13 3/8 inch LS casing is used as the conductor pipe. This pipe was manually grouted using 15 sacks of Type 1 cement (Class A/Portland cement).
- 1110 feet KB of 26 lb/ft, 9 5/8 inch LS casing is used as the primary water protection string. Prior to cementing, the well bore was cleaned and conditioned by circulating drilling mud for one hour. The casing was cemented using 425 sacks of Class A cement containing 2% Calcium Chloride, ¼ lb per sack of Celloflake [water-loss agent] and 0.2% D 46 [defoamer]. The 9 5/8 was equipped with two centralizers and one cement basket. It should be noted that approximately 13 barrels of the cement slurry were recovered at the surface in the well pit.
- 2025 feet KB of 23 lb/ft, 7 inch J-55 casing is used as the intermediate string. The 8 3/4 inch hole was drilled on air. 200 sacks of Class A cement containing 4% D 020 (Bentonite Gel), 2% Calcium Chloride, 0.2% of defoamer, 0.4% Uniflac, and ¼ lb per sack of Celloflake, were then displaced by the tail slurry, which was comprised of 108 sacks of Class A cement containing .75 gallons per sack of D 500 [Gas Blok LT], .2% D 46, and D 201. These slurries were then displaced by 24 barrels of fresh water. It should be noted that approximately 5 barrels of the cement slurries were recovered at the surface in the well pit. The 7 inch was equipped with three centralizers.
- 9690 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing was used as the production string. Prior to cementing, 50 barrels of treated fluid was pumped into the casing. The 4 ½ inch casing was cemented from the

cement port collar at 5760 feet KB to 760 feet KB. The procedure utilized was to open the port, circulate the hole with 50 barrels of treated fluid and then cement using 440 sacks of Class A cement containing 0.1% D 201 (cement enabler/retardant), 0.2% D 46 and ¾ gallon of D 500 latex. The cement was displaced using 20 barrels of fluid. Subsequent to the cementing process, a CBL conducted by Schlumberger indicated a 100% bond from 5760 feet to 760 feet.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

G. Ely No. 7H SE (API No. 37-115-20160-00) [See, App., Ex. 1, Tab G]

A review of the well history and completion record indicates that the well is equipped as follows:

- 92 feet KB of 63 lb/ft, 16 inch LS casing is used as the conductor pipe. This pipe is set in place.
- There was a freshwater show at 115 feet.
- 1510 feet KB of N-80 40 lb/ft, 9 5/8 inch casing is used as the primary water protection string. This pipe is cemented in place. The hole was drilled using air. Prior to cementing, Superior Well Services cleaned and conditioned the hole using a mixture of freshwater and 6% gel. 611 sacks of Class A cement containing 3% Calcium Chloride, 0.075% of LP 2, ½ lb per sack of Superflake, CD 20 and 0.2% of AirOut was displaced into the annulus using 111 barrels of freshwater. It should be noted that approximately 15 barrels of the cement slurry were recovered at the surface in the well pit.
- 9915 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. The 4 ½ casing was cemented from the cement port collar at 6012 feet. Prior to cementing, Schlumberger Well Services conditioned the well using 60 barrels of freshwater, followed by 50 barrels of 6% gel and then 10 barrels of freshwater. 219-sacks of Class A 50/50 pozmix, 0.2% by weight of dry cement, 2% D 020, 0.2% D 046, 0.2% D 65 (dispersant/turbulence inducer), and 0.3% D 165 (Uniflac-S) was used as the lead cement. The lead cement slurry was then displaced by the tail slurry and was made up of 108 sacks of Class A, containing 0.75 gallons per sack of D 500 GasBlok LT, 0.2% D 46, and D 201 (basic cement enabler-retardant). These slurries were then displaced by 24 barrels of

freshwater. JW Wireline subsequently ran a CBL, which indicated that the top of cement was at 3000 feet.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

H. Gesford No. 2H (API No. 37-115-20033-00) [See, App., Ex. 1, Tab H]

A review of the well schematic and the well history indicates that the well is equipped as follows:

- 46 feet KB of 37 lb/ft, 13 3/8 inch LS casing is used as the conductor pipe. This pipe is set in place and grouted using 40 sacks of Portland cement.
- There were freshwater shows at 81 and 480 feet.
- 1036 feet KB of 32.3 lb/ft, 9 5/8 inch H-40 casing is used as the primary water protection string. Prior to running the casing, the hole was cleaned for 30 minutes and then conditioned using 35 barrels of freshwater followed by 25 barrels of freshwater with Flake, followed by 35 barrels of freshwater. Schlumberger Well Services then cemented the annular space using 350 sacks of Class A cement containing 2% Calcium Chloride, ¼ lb per sack of Celloflake, and 0.2% of D 046. The cement slurry was then displaced using 77.4 barrels of freshwater. It should be noted that approximately 10 barrels of the cement slurry were recovered at the surface in the well pit
- 1575 feet KB of 23 lb/ft, 7 inch J-55 casing was used as an intermediate string. Halliburton provided the services associated with the cementing of the 7 inch casing. The hole was first cleaned and conditioned by pumping 25 barrels of freshwater, followed by 20 barrels of gel with Flake, and then 20 barrels of freshwater. 116 sacks of Class A cement containing 4% gel and 2% Calcium Chloride were used as the lead slurry. The tail slurry was made up of 100 sacks of Class A cement containing 2% Calcium Chloride. These slurries were then displaced with freshwater. It should be noted that approximately 8 barrels of the cement slurry were recovered at the surface in the well pit.
- 7143 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. The well bore was cleaned and conditioned by pumping 20 barrels of freshwater. It was then cemented using 150 sacks of Class A cement containing 2% gel and 2% Calcium Chloride. The cement was then displaced using 110 barrels of freshwater.

- Using a gamma ray/CCL (casing collar locator)/bond/VDL, Schlumberger Wireline indicated that the top of the cement was at 5440 feet KB. The bond index was indicated to be 50-90%.
- Subsequent analysis of the available data collected during drilling (the hole was drilled using air) indicated gas shows at the approximate depths of: 2005 feet KB; 2396 feet KB; 3010 feet KB; and 5083 feet KB. Because of these gas shows, Cabot undertook the squeezing of the open annular space.
- On April 1, 2009, the 4 ½ inch casing was perforated from 5300 to 5302 feet for the purpose of undertaking a squeeze. The well bore was then conditioned using 160 barrels of 2% KCL and squeezed with 380 sacks of Type I cement (Class A/Portland common cement), containing .1% defoamer, .2% fluid loss and latex. The well history indicates that the top of the cement following the squeeze was determined by CBL to be 1075 feet KB.
- 6828 feet KB of 4.7 lb/ft, 2 3/8 inch J-55 EUE was used as a velocity string.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

I. Hubbard No. 5H (API No. 37-115-20148-00) [See, App., Ex. 1, Tab I]

A review of the well schematic and the well history indicates that the well is equipped as follows:

- 40 feet KB of 37 lb/ft, 13 3/8 inch LS casing was used as the conductor pipe. This pipe was set in place and grouted using 18 sacks of Type 1 cement (Class A/Portland cement).
- There was a freshwater show at 157 feet.
- The well was circulated and cleaned using water prior to running the next casing string.
- 912 feet KB of 32.3 lb/ft, 9 5/8 inch LS casing is used as the primary water protection string. The casing was then cemented by first displacing a 103 barrel gel/water spacer into the annulus for the purposes of cleaning and conditioning the well bore. This was followed by 280 sacks of Class A containing 3% Calcium Chloride, ½ lb per sack of Flake, 0.75% LP 2,

0.2% CD 20, and 0.2% AirOut (powdered defoamer). The cement slurry was displaced using 68 barrels of freshwater. Further, it should be noted that approximately 5 barrels of the cement slurry were recovered at the surface in the drilling pit.

- 1530 feet KB of J-55 23 lb/ft 7 inch casing. Prior to cementing, 103 barrels of gel/water spacer was mixed and pumped into the well. Superior Well Services then displaced 160 sacks of Class A cement containing 3% Calcium Chloride, 0.5 lbs per sack of Flake, 0.75% of LP 2, 0.2 % of CD 20, and 0.2 % of AirOut. The cement slurry was then displaced with 58 barrels of water. The top of the cement was calculated to be 128 feet KB. The annular space between the 7 inch and the 9 5/8 inch casing was grouted using 25 sacks of Class A cement containing 3% Calcium Chloride. The grouting operation brought the cement level in the annulus to the surface.
- 9046 feet KB of 11.6 lb/ft, 4 1/2 inch P-110 casing. A Baker cement collar is located at 6105 feet KB. The hole was loaded with 2 barrels of freshwater, and the annulus was then opened to establish communication between the well bore and the 6 1/4 inch drilled hole.
- Schlumberger circulated the well hole with freshwater to remove the drilling mud from the hole. 35 barrels of 6% gel, 5 barrels of freshwater spacer, 35 barrels of 35-65 Pozmix, 70 barrels of 50-50 Pozmix with GasBlok and 35 barrels of poz neat (water and cement only) were displaced with 87 barrels of freshwater. It should be noted that approximately 3 barrels of the cement slurry was recovered at the surface in the drilling pit.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

J. Ratzel No. 1H (API No. 37-115-20047-00) [See, App., Ex. 1, Tab J]

A review of the well schematic and the well history indicates that the well is equipped as follows:

- Spudded 17 1/2 hole, drilled to 38 feet, could not clean hole because of glacial till. Reamed hole to 22 inch and ran 34 feet KB of 78.7 lb/ft 20 inch LS casing. This pipe is set in place and grouted using Portland cement. This pipe is used as a conductor pipe.

- 186 feet KB of 37 lb/ft, 13 3/8 inch LS casing is used as a second conductor. The casing was circulated with spud mud for 5 hours. The 13 3/8 inch casing was then cemented using 200 sacks of Type 1 cement (Class A/Portland cement) containing 3% Calcium Chloride. Further, it should be noted that approximately 5 barrels of the cement slurry was recovered at the surface in the drill pit.
- There was a freshwater show at 285 feet KB.
- 868 feet KB of 32.3 lb/ft, 9 5/8 inch H-40 casing is used as the primary water protection string. Prior to running the casing, the hole was circulated to clean and condition it. Prior to running cement, 40 barrels of fresh water were circulated in the hole, followed by 377 sacks of Class A cement, containing 2% Calcium Chloride. The cement was then displaced using 67 barrels of freshwater. It should be noted that 12 barrels of cement slurry was recovered at the surface in the drilling pit. It was also observed that the cement level held at the surface.
- 1524 feet KB of J-55, 23 lb/ft, 7 inch casing is used as the intermediate string. Prior to running the 7 inch casing, Schlumberger Well Services circulated the hole for the purposes of cleaning and conditioning. Prior to displacement of the cement, 40 barrels of freshwater was pumped, followed by 40 barrels of 6% gelled water, and then followed by 40 barrels of freshwater spacer. 135 sacks of Class A cement containing 4% gel, 2% Calcium Chloride, 0.2% defoamer, and ¼ lb per sack of Flake, were displaced as the lead cement slurry. 110 sacks of Class A cement containing 2% Calcium Chloride, and ¼ lb per sack of Flake was used as the tail cement. These cement slurries were displaced with 57 barrels of freshwater.
- There was a 25 mcf gas show at 1558 feet.
- 9485 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. Centralizers were run every fourth joint from the kick off point to 1107 feet KB. Schlumberger Well Services cemented the 4 ½ inch casing using the following procedure: 20 barrels of mud push were displaced. This was followed by 55 barrels of lead cement (Class A cement containing 4% D 020, 0.2% D 046, 0.35% D 201, 0.2% D 135), 50 barrels of lead cement (Class A containing 4% of D 020, 0.5% D 167, 0.5% D 065, 0.2% D 46, and 0.3% of D 201) then 72 barrels of tail cement (Class A containing 0.3% D 167, 0.4% D 201, 0.2% D 046, 2% D 020, 0.5% D 065), followed by 10 barrels of mud push, and displaced by 147 barrels of 2% KCl. The top of the cement was determined to be 2650 feet KB using the bond log.
- 6986 feet KB of 4 lb/ft, 2 3/8 EUE J-55 tubing was used as a velocity string.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

K. Ratzel No. 2H (API No. 37-115-20152-00) [See, App., Ex. 1, Tab K]

A review of the well history indicates that the well is equipped as follows:

- 41 feet KB of 78.7 lb/ft, 20 inch LS casing was used as the conductor string. This pipe is grouted in place by pumping 20 sacks of common Portland cement down the 20 inch. The 20 inch was then reciprocated, and 15 sacks of common Portland cement were pumped down the annulus.
- There were freshwater shows at 105 feet and 710 feet.
- 127 feet KB of 37 lb/ft, 13 3/8-inch LS casing was used as a second conductor as well as a water protection string. Prior to cementing, Schlumberger Well Services pumped 5 barrels of freshwater, followed by 20 barrels of 6% gel, followed by 55 barrels of freshwater to clean and condition the well bore. Schlumberger Well Services then pumped 55 barrels of Class A cement containing PAD 500 (GasBlok).
- 844 feet KB of 32.3 lb/ft, 9 5/8 inch H-40 casing was used as the primary water protection string. Prior to cementing the 9 5/8 inch, 10 barrels of freshwater, 40 barrels of 6% gel and 10 barrels of freshwater were pumped to clean and condition the well bore. 330 sacks of Class A cement containing PAD 500 was then displaced into the annular space with 63 barrels of freshwater. It should be noted that approximately 5 barrels of cement slurry was recovered at the surface in the well pit. There are 5 centralizers, 1 for every other joint, and a cement basket at 275 feet.
- 1492 feet KB of 23 lb/ft, 7 inch J-55 casing was used as an intermediate string. Schlumberger Well Services first pumped 10 barrels of freshwater, 40 barrels of 6% gel, 40 barrels of freshwater to clean and condition the well bore. The annular space was then cemented using 275 sacks of Class A cement containing PAD 500. It should be noted that approximately 5 barrels of the cement slurry was recovered at the surface in the well pit.
- 9228 feet KB of 11.6 lb/ft, 4 1/2 inch P-110 casing was used as the production string. Prior to cementing, the annular space was circulated with 100 barrels of freshwater. No gas cut was indicated in the returns. 35 barrels of 6 % gel and 5 barrels of freshwater spacer were then pumped to clean and condition the well bore. 350 sacks of 35/65 pos [35% pozzoan, 65% Portland/Class A] containing 6% Bentonite gel, 0.2% fluid

loss control additive, and 0.2% dispersant were then displaced into the annulus. [First 53 barrels of cement slurry included .75 gallons per sack of latex the second 53 barrels were pumped without latex.] The cement port for the 4 ½ inch casing is located at 6208 feet.

- According to the well history, the top of the cement was determined to be 2350 feet by using a CBL.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

- L. R. Smith No. 4 (API 37-115-20075-00) (Cabot filed two completion reports, one under 37-115-20075 and one under API 37-115-20040) [See, App., Ex. 1, Tab L]

A review of the well history and completion report indicates that the well is equipped as follows:

- 48 feet KB of 37 lb/ft, 13 3/8 inch, LS casing is used as the conductor pipe. The pipe is set in the hole and the annular space filled with 60 sacks of Class A cement.
- Fresh water shows at 37 feet and 665 feet.
- 842 feet KB of 32.3 lb/ft, 9 5/8 H-40 casing is used as a water protection string. Prior to cementing the well, Schlumberger Well Services pumped 5 barrels of freshwater followed by 20 barrels of mud flush, and then 5 barrels of freshwater to clean and condition the well bore. 330 sacks of Class A cement containing GasBlok were then placed into the well annulus. Centralizers were placed on joints 1, 5, 9, 13, and 17. Cement baskets were placed on joints 11 and 14.
- 1486 feet KB of 23 lb/ft, 7 inch, J-55 casing is used as the intermediate string. Prior to running the casing, the hole was circulated for the purposes of cleaning and conditioning the hole for the pipe. Centralizers were placed on joints 1, 5, 9, 13, 17, 21, 25 and 29. Cement baskets were placed on joints 7 and 14. Prior to pumping the cement, Schlumberger Well Services pumped 10 barrels of freshwater, 40 barrels of 6% gel, and 20 barrels of freshwater. 300 sacks of Class A cement containing GasBlok was then displaced into the annular space using 58 barrels of freshwater. It should be noted that approximately 11 barrels of the cement slurry were recovered at the surface in the well pit.

- 7540 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. Given that the hole was drilled on air, the hole was first loaded with 300 barrels of KCl water. Schlumberger mixed and pumped 30 barrels of a freshwater spacer, followed by lead slurry of 350 sacks and 150 sacks of a tail slurry. The cement used was Class A and contained .75 gallons per sack of D 500, 0.2% D 46, and 0.1% D 201. Using the CBL, the top of the cement was measured to be at 1490 feet KB.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

M. Teel No. 5 (API No. 37-115-20024-00) [See, App., Ex. 1, Tab M]

A review of the well history and completion report indicates that the well is equipped as follows:

- 38 feet KB of 37 lb/ft, 13 3/8 inch LS casing is used as the conductor pipe. Annular space grouted with 40 sacks of redi-mix cement, common Portland.
- Freshwater shows at 80 and 740 feet KB.
- 807 feet KB of 26 lb/ft, 9 5/8 inch LS casing is used as the primary water protection string. Prior to running the casing, the hole was circulated for 1 hour for the purpose of cleaning it. Prior to displacing the cement into the well, BJ services pumped 10 barrels of freshwater, followed by 25 barrels of 6% gel, and then 10 barrels of freshwater spacer. 300 sacks of Class A cement containing 2% Calcium Chloride was then mixed and pumped. The cement slurry was displaced with 60 barrels of freshwater. It should be noted that approximately 12 barrels of the cement slurry were recovered at the surface in the well pit.
- 1518 feet KB of 19 lb/ft, 7 inch LS casing is used as the intermediate string. Prior to running the casing, the hole was cleaned and conditioned. The cement string was equipped with 3 centralizers and 2 cement baskets. Prior to displacing the cement, BJ Services pumped 20 barrels of freshwater, 40 barrels of 6% gel and 10 barrels of freshwater spacer. The cement was then mixed and pumped. The lead slurry was made up of 135 sacks of Class A cement containing 2% Calcium Chloride, 4% gel, 0.2% DF, 0.4% FL and ¼ lb per sack of Flake. This tail cement was made up of 115 sacks of Class A containing 2% Calcium Chloride. These cement slurries were displaced with 58 barrels of freshwater. It should be noted

that approximately 10 barrels of the cement slurry were recovered at the surface in the well pit.

- 7115 feet KB of 11.6 lb/ft, 4 ½ inch P-110 casing is used as the production string. The casing was run using 10 centralizers. First 5 barrels of freshwater were pumped. This was followed by 200 sacks of Type 1 cement (Class A/Portland cement) containing 2% Calcium Chloride, and 2% Bentonite gel. The cement slurry was displaced into the annular space using 109 barrels of freshwater. Using the CBL, the top of the cement was determined to be 4750 feet KB.
- 6986 feet KB of 4 lb/ft, 2 3/8 EUE J-55 tubing was used as a velocity string.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

N. Teel No. 7 (API No. 37-115-20023-00) [See, App., Ex. 1, Tab N]

A review of the schematic, well history and completion report indicates that the well is equipped as follows:

- 54 feet KB of 37 lb/ft, 13 3/8 inch LS was used as the conductor pipe. The pipe was set in the hole.
- Freshwater shows at 85 feet, 250 feet, 400 feet and 710 feet KB.
- 358 feet KB of 26 lb/ft, 9 5/8 inch LS casing was used as the first water protection string. Prior to running the casing, the hole was circulated to clean and condition it. In terms of the cementing operation, BJ Services first pumped 10 barrels of freshwater. This was followed by 10 barrels of 6% gel, and then 10 barrels of freshwater. 140 sacks of Class A with 2% Calcium Chloride and ¼ lb per sack of Flake were then mixed and pumped. The cement slurry was displaced using 26 barrels of freshwater. It should be noted that cement slurry returns were observed at the surface. Centralizers were run on joints 2 and 7 and a cement basket on joint 7.
- 1496 feet KB of 19 lb/ft, 7 inch LS casing was used as the intermediate and second water protection string. Prior to running the casing, the hole was circulated for 45 minutes to clean and condition it. BJ Services then pumped 5 barrels of freshwater, 40 barrels of 3% gel, and 15 barrels of freshwater. 140 sacks of Class A cement containing 2% Calcium Chloride and 4% gel was used as the lead cement slurry. 100 sacks of Class A

cement containing 2% Calcium Chloride were used as the tail cement. The cement slurry was then displaced into the annulus using 5 barrels of freshwater. It should be noted that approximately 11 barrels of the cement slurry were recovered at the surface in the well pit. Centralizers were utilized according to the program.

- Gas shows at 2575 feet, 3008 feet, and 5500 feet KB.
- 7118 feet KB of 11.6 lb, 4 ½ inch P-110 casing was used as the production casing. Cementing operations involved the pumping of 10 barrels of freshwater, followed by 20 barrels of UltraFlush, 24 barrels of Sure Bond, and 10 barrels of freshwater. BJ Services mixed and pumped 175 sacks of Class A cement containing 2% Calcium Chloride and 2% gel. The cement slurry was displaced into the annular space using 109 barrels of freshwater. Using a CBL, the top of cement was determined to be 4700 feet KB. Centralizers were utilized according to the program.
- 6986 feet KB of 4 lb, 2 3/8 EUE J-55 tubing was used as a velocity string.

As illustrated in the Appendix, the tubular goods used in this well met the environmental parameters of the well. Also, the procedures used in the cementing the well including hole conditioning and cleaning are typical. The service companies provided cement that met the specifications associated with API Class A, Type 1 and Common Portland cements. Additives were used to adapt the cement to this well and its conditions. The cement and its additives are also listed in the Appendix.

IV. Summary and Conclusions

At the request of Cabot, I have reviewed the wells that are identified in the Modification for adequacy of casing and cement. To accomplish these tasks, an extensive/intensive review of all available data concerning these wells was undertaken. This included the daily well history that was based on the daily reports that are filed by the well site supervisor each morning. These reports describe in detail the field activities associated with the drilling, equipping, and completion of these wells. Moreover, I also considered other data that included technical specifications of the tubular goods such as minimum and ultimate yield (psi), thread-type (8-round, long/short), collapse pressure (psi), internal yield pressure (psi)/burst pressure (psi), body yield strength (lbs), and joint strength (lbs).

Also, I considered the cement and additives used in the cementing of the wells. The cement and additives used by Cabot were obtained from four service companies: (i) Halliburton; (ii) Schlumberger; (iii) Superior; and (iv) BJ Services. In each instance, the service company provided the pumping services necessary to mix and place the cement. In terms of the 3 gas wells that were to be plugged in accordance with the Modification, I reviewed the plugging plan that was submitted to the PA DEP and its execution as described in the daily well history.

With a view to future development of its properties in Susquehanna County and to comply with the proposed changes to the requirements of Pennsylvania Law as set forth in the Oil and Gas Act and Pennsylvania Code, Cabot has undertaken a review of its well design that includes a review of the casing program and cement to be used and has proposed new standard for operating procedures. My review of Cabot's proposed well design indicates that it will comply with the proposed changes to the requirements of Pennsylvania Law as set forth in the Oil and Gas Act.

Thus, I conclude the following:

- The well design employed by Cabot and the remedial actions taken on certain wells meet the requirements of Pennsylvania Law as set forth in the Oil and Gas Act and Pennsylvania Code;
- Cabot has used and is using procedures for drilling, casing and cementing that meet or exceed the requirements of the Pennsylvania Oil & Gas Act;
- Cabot has used and is using procedures for drilling, casing and cementing that are at least equivalent to, if not better than, other producers in the industry;
- No Cabot well that has been drilled or plugged is currently causing or allowing methane migration into groundwater;
- The procedures Cabot is utilizing for natural gas well development in Susquehanna County are not causing or allowing methane migration into the waters of the Commonwealth;
- The procedures Cabot intends to use in the future for natural gas well development in Susquehanna County will not cause or allow methane migration into the waters of the Commonwealth.

More specifically,

- Cabot has plugged the Gesford Nos. 3 & 9 Wells and Baker 1 Well in accordance with 25 Pa. Code §§ 78.91-78.95;
- Cabot has undertaken the cement remedial work necessary for the Ely No. 4 Well as required by the Modification;
- The current configurations contained within the subsurface elements of the remaining 10 wells identified in the Modification comply with 25 Pa. Code §§ 78.91-78.98. This includes the casing used, the methodology employed in terms of cleaning and conditioning the hole, and the cement and additives used in the completion process.

/s/ Robert W. Watson, Ph.D., P.E
Robert W. Watson Ph.D., P.E.